# CHF and PCF Integration for Access and Mobility Procedures

# Feature Summary and Revision History

## Summary Data

Table 1: Summary Data

| Applicable Product(s) or Functional Area | SMF |
|---|---|
| Applicable Platform(s) | SMI |
| Feature Default Setting | Enabled - Always-on |
| Related Changes in this Release | Not Applicable |
| Related Documentation | Not Applicable |

## Revision History

Table 2: Revision History

| Revision Details | Release |
|---|---|
| First introduced. | Pre-2020.02.0 |

# Feature Description

The SMF leverages the 3GPP provision for the access and mobility procedures. With this provision, the SMF integrates the Charging Function (CHF) and Policy Control Function (PCF). SMF supports the following integration functions:

- CHF and PCF Integration for Intra-AMF and Inter-AMF N2-Based Handovers—SMF supports this function when a UE moves from one NG-RAN to another NG-RAN for Data Forwarding Tunnel (DFT) and Indirect Data Forwarding Tunnel (IDFT) cases.

- CHF and PCF Integration for N26 4G to 5G Handover—SMF supports the EPS to 5GS procedures with the N26 interface. SMF establishes Uplink (UL) Packet Detection Rule (PDR) or Downlink (DL) PDR toward with the qualified EPS Bearer Identity (EBI) list in 5GS and replicate EBIs to the respective flows. SMF also creates IDFT to support the Downlink forwarding traffic between SGW-U to NR over UPF.

- CHF and PCF Integration for N26 5G to 4G Handover—SMF supports 5GS to EPS procedures with the N26 interface. PGW-C establishes UL PDRs or DL PDRs toward SGW-U with qualified flows in 5GS and replicate EBIs to respective flows. PGW-C also creates an IDFT tunnel to support Downlink forwarding traffic between NR to SGW-U over UPF. Session-Level or Rating-Group level Charging Triggers are received during PDU Session establishment or in response to SMF-initiated Charging Update Request or CHF-initiated Charging Update Notify response in EPS procedures.

- CHF and PCF Integration for Xn Handover—SMF supports the Xn-based inter NG-RAN handover with and without UPF reallocation. The SMF supports Xn handovers for intra-AMF mobility only. SMF processes the received SM context update request that includes the path switch request N2-based message and the access-ide parameters. These parameters identify the CHF and PCF triggers that are received during PDU session establishment.

- CHF and PCF Integration for Service Request Procedures—SMF supports the service requests from both the UE and network-initiated procedures. Either a UE in CM-Idle state or the 5GC uses the Service Request procedure to request the establishment of a secure connection to an AMF. The UE in both the CM-Idle and in CM-Connected state use the Service Request procedure to activate a User Plane connection for an established PDU Session. The UE does not initiate a Service Request procedure if an ongoing Service Request procedure exists.

SMF saves the CHF and PCF triggers that SMF receives from CHF and PCF as part of session creation or PCF or UE-initiated modifications. When a UE triggers access and mobility procedures for the preceding functions, SMF identifies the triggers from CHF and PCF against the received access parameters. Then, SMF sends an update toward CHF and PCF.

# How it Works

The SMF integrates the CHF and PCF functions based on the following information:

- Policy control request triggers that are received in the SM policy decision while PDU session is established or PCF or UE initial modification.

- Session-level or rating-group-level charging triggers that are received while PDU session is established or in response to SMF-initiated Charging Update Request or CHF-initiated Charging Update Notify Request.

The SMF supports the following access-side information to detect the PCF and CHF triggers. The SMF sends the trigger information to the CHF and PCF during the N2-based handover.

*Table 3: Access-Side Information for PCF and CHF Triggers*

| Access-Side | CHF-Triggers | PCF-Triggers |
| --- | --- | --- |
| UserLocation | USER_LOCATION_CHANGE | SAREA_CH |
| UeTimeZone | UE_TIMEZONE_CHANGE | SAREA_CH |
| ServingNetwork | PLMN_CHANGE | PLMN_CH |
| TargetServingNfId | SERVING_NODE_CHANGE | |

# Call Flows

This section describes the following call flows:

- CHF and PCF Integration for Intra-AMF and Inter-AMF N2-Based Handovers Call Flow

- CHF and PCF Integration for N26 4G to 5G Handover Call Flow

- CHF and PCF Integration for N26 5G to 4G Handover Call Flow

- CHF and PCF Integration for Xn Handover Call Flow

- CHF and PCF Integration for Service Request Procedures

## CHF and PCF Integration for Intra-AMF and Inter-AMF N2-Based Handovers Call Flow

This section describes the call flow for the CHF and PCF Integration for Intra-AMF and Inter-AMF N2-based handovers.

*Figure 1: CHF and PCF Integration for Intra-AMF and Inter-AMF N2-Based Handovers Call Flow*
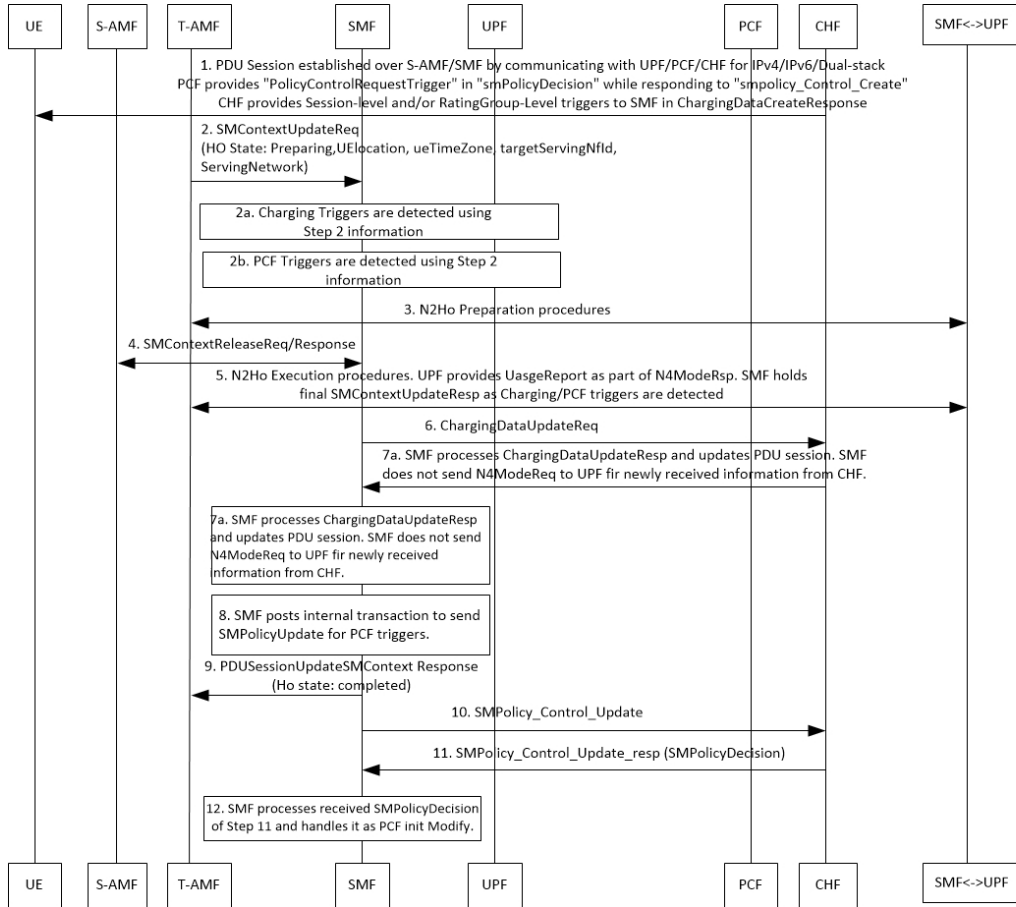


*Table 4: CHF and PCF Integration for Intra-AMF and Inter-AMF N2-Based Handovers Call Flow Description*

| Step | Description |
|------|-------------|
| 1 | The PDU session is established over S-AMF and SMF by communicating with UPF, PCF, or CHF for IPv4, IPv6, or dual-stack.<br><br>The PCF provides Policy Control Request trigger for SM policy decision as response to the request for creation of SM policy control.<br><br>The CHF provides session-level and rating-group-level triggers to SMF as the Charging Data Create Response. |
| 2 | The T-AMF sends SM Context Update Request by including handover state to the SMF. The handover state includes the information on preparation, UE location, UE time zone, target serving NFID, and serving network. The AMF includes target serving NFID information for inter-AMF handoff. |
| 2a | The SMF detects access-side changes that are received in the SM Context Update Request and the charging triggers with the information that is available in Step 2. |
| 2b | The SMF detects the PCF triggers with the information that is available in Step 2. |

| Step | Description |
|------|-------------|
| 3 | The N2-based Handover Preparation procedure starts from T-AMF towards the SMF and CHF and vice-versa. |
| 4 | In the N2-based Handover Execution procedure, in case of inter-AMF handoff, the SMF receives SM Context Release Request from S-AMF and responds with the SM Context Release Response to the S-AMF. |
| 5 | In N2-based Handover Execution procedure, the UPF provides the usage report as part of N4 modification response. The SMF holds the final SM Context Release Response when the SMF detects the CHF or PCF triggers. |
| 6 | The SMF sends the Charging Data Update Request to the CHF. This request includes the information on session-level triggers, multi-unit-Information (with rating-group-level triggers with usage report), customer identification, and PDU session charging information. |
| 7 | The CHF sends the Charging Data Update Response with optional multi-unit-information. The CHF also sends the new session or rating-group-level triggers to the SMF. |
| 7a | The SMF processes the Charging Data Update Response and updates the PDU session. The SMF does not send the N4 modification request to the UPF for the newly received information from the CHF. |
| 8 | The SMF posts the internal transaction to send the SM policy update information for PCF triggers. |
| 9 | The SMF sends the SM Context Update Response, for which the handover state is complete, to the T-AMF. |
| 10 | The SMF sends the SM Policy Control Update information to the PCF. The SM Policy Control Update information includes details, such as the user location information, UE time zone, and serving network. |
| 11 | The PCF sends the SM Policy Control Update Response, which is the SM policy decision, to the SMF. |
| 12 | The SMF processes the SM policy decision that is received as response and handles the response as PCF Initiation Modify procedure. |

## CHF and PCF Integration for N26 4G to 5G Handover Call Flow

This section describes the call flow for the CHF and PCF Integration for N26 4G to 5G handovers.

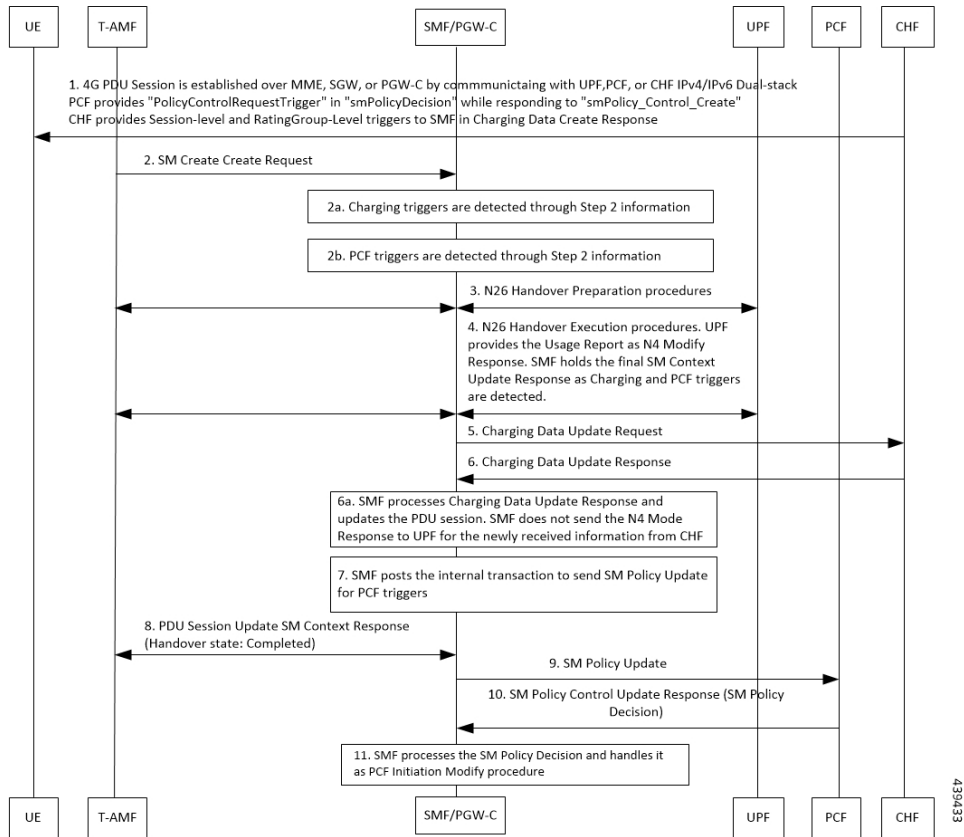*Figure 2: CHF and PCF Integration for N26 4G to 5G Handover Call Flow*



*Table 5: CHF and PCF Integration for N26 4G to 5G Handover Call Flow Description*

| Step | Description |
|---|---|
| 1 | The PDU session is established over MME, SGW, and SMF by communicating with UPF, PCF, or CHF for IPv4, IPv6, or dual-stack.<br><br>The PCF provides Policy Control Request trigger for SM policy decision as response to the request for creation of SM policy control.<br><br>The CHF provides session-level and rating-group-level triggers to SMF as the Charging Data Create Response. |
| 2 | The T-AMF sends SM Context Update Request by including handover state to the SMF. The SM Context Update Request includes the information on handover state as preparing, UE location, UE time zone, serving NFID, serving network, and RAT type. |
| 2a | The SMF detects access-side changes that are received in the SM Context Create Request and the charging triggers with the information that is available in Step 2. |
| 2b | The SMF detects the PCF triggers with the information that is available in Step 2. |
| 3 | The N26-based Handover Preparation procedure starts from T-AMF toward the SMF or PGW-C and UHF and vice versa, as defined in 3GPP TS 23.502, section 4.1.9.3. |

| Step | Description |
|------|-------------|
| 4 | In the N26 Handover Execution procedure, the UPF sends the usage report as part of N4 modification response to SMF. The SMF holds the final SM Context Update Response when the SMF detects the CHF or PCF triggers. |
| 5 | The SMF sends the Charging Data Update Request to the CHF. This request includes the information on session-level triggers, multi-unit-Information (with rating-group-level triggers and usage report), customer identification, and PDU session charging information. |
| 6 | The CHF sends the Charging Data Update Response with optional multi-unit-information. The CHF also sends the new session or rating-group-level triggers to the SMF. |
| 6a | The SMF processes the Charging Data Update Response and updates the PDU session. The SMF does not send the N4 modification request to the UPF for the newly received information from the CHF. |
| 7 | The SMF posts the internal transaction to send the SM policy update information for PCF triggers. |
| 8 | The SMF sends the SM Context Update Response, for which the handover state is complete, to the AMF. |
| 9 | The SMF sends the SM Policy Control Update information to the PCF. The SM Policy Control Update includes details, such as the user location information, UE time zone, and serving network. |
| 10 | The PCF sends the SM Policy Control Update Response, which is the SM policy decision, to the SMF. |
| 11 | The SMF processes the SM policy decision that is received as response and handles the response as PCF Initiation Modify procedure, as defined in 3GPP TS 23.502, section 4.3.3.2. |

## CHF and PCF Integration for N26 5G to 4G Handover Call Flow

This section describes the call flow for the CHF and PCF Integration for N26 5G to 4G handovers.

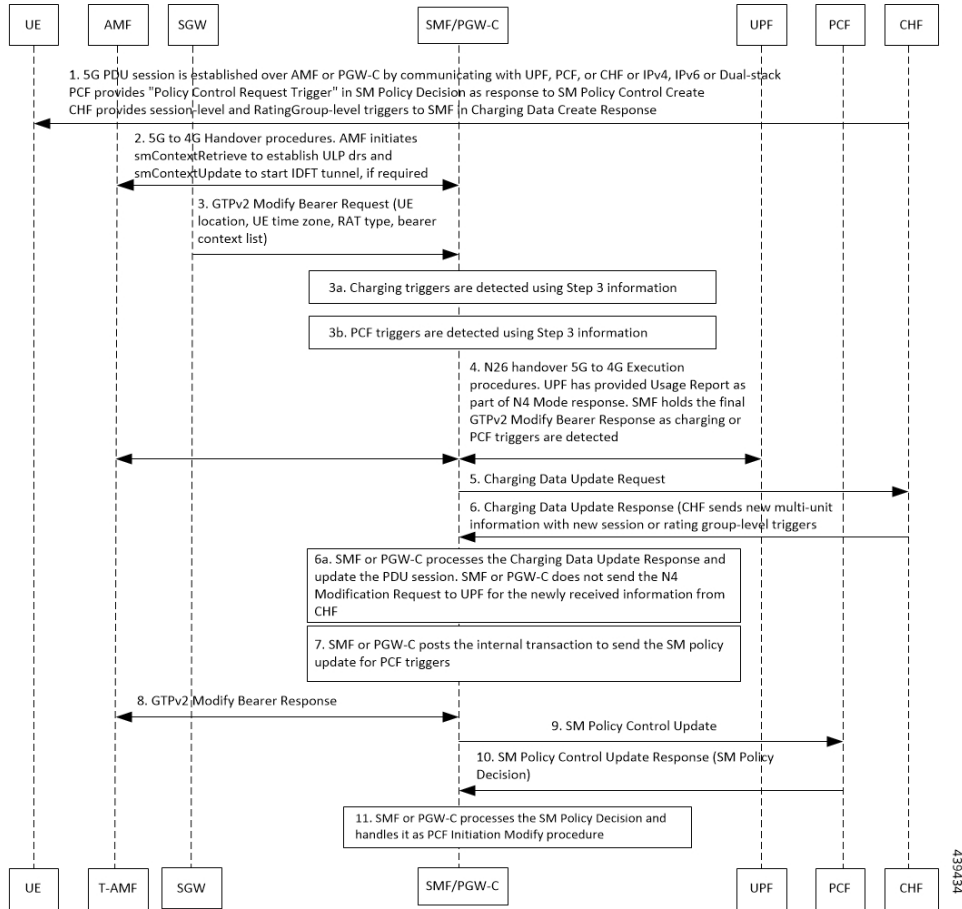*Figure 3: CHF and PCF Integration for N26 5G to 4G Handover Call Flow*



*Table 6: CHF and PCF Integration for N26 5G to 4G Handover Call Flow Description*

| Step | Description |
|---|---|
| 1 | The PDU session is established over S-AMF or SMF by communicating with UPF, PCF, or CHF for IPv4, IPv6, or dual-stack. |
| | The PCF provides Policy Control Request trigger for SM policy decision as response to the request for creation of SM policy control. |
| | The CHF provides session-level and rating-group-level triggers to SMF as the Charging Data Create Response. |
| 2 | The 5G to 4G Handover procedure starts from AMF toward the SMF or PGW-C and vice versa. AMF initiates the SM Context Retrieve Request to establish the UL PDRs and send SM Context Update Response to start the IDFT tunnel, if necessary. |
| 3 | In the N26 5G to 4G Handover Execution procedure, the SGW sends the GTPv2 Modify Bearer Request to PGW-C. This request includes the information on UE location, UE time zone, RAT type, and Bearer Context List. |
| 3a | The SMF detects access-side changes that are received in the SM Context Update Request and the charging triggers with the information that is available in Step 3. |

| Step | Description |
|------|-------------|
| 3b | The SMF detects the PCF triggers with the information that is available in Step 3. |
| 4 | In the N26 Handover 5G to 4G Execution procedure, the PGW-C requests UPF to create a GTP-U tunnel for each flow. This tunnel is for the EBIs received in the Bearer Context List of GTPv2 Modify Bearer Request. After the DL PDRs are established, UPF sends the usage report as part of N4 modification response to SMF. The SMF holds the final GTPv2 Modify Bearer Response when the SMF detects the CHF or PCF triggers. |
| 5 | The SMF sends the Charging Data Update Request to the CHF. This request includes the information on session-level triggers, multi-unit-Information (with rating-group-level triggers and usage report), customer identification, and PDU session charging information. |
| 6 | The CHF sends the Charging Data Update Response with optional multi-unit-information. The CHF also sends the new session or rating-group-level triggers to the SMF. |
| 6a | The SMF or PGW-C processes the Charging Data Update Response and updates the PDU session. The SMF does not send the N4 modification request to the UPF for the newly received information from the CHF. |
| 7 | The SMF or PGW-C posts the internal transaction to send the SM policy update information for PCF triggers. |
| 8 | The SMF or PGW-C sends the SM Context Update Response, for which the handover state is complete, to the AMF. |
| 9 | The SMF or PGW-C sends the SM Policy Control Update information to the PCF. The SM Policy Control Update includes details, such as the user location information, UE time zone, and serving network. |
| 10 | The PCF sends the SM Policy Control Update Response, which is the SM policy decision, to the SMF. |
| 11 | The SMF processes the SM policy decision that is received as response and handles the response as PCF Initiation Modify procedure, as defined in 3GPP TS 23.502, section 4.3.3.2. |

## CHF and PCF Integration for Xn Handover Call Flow

This section describes the call flow for the CHF and PCF Integration for the Xn handover.

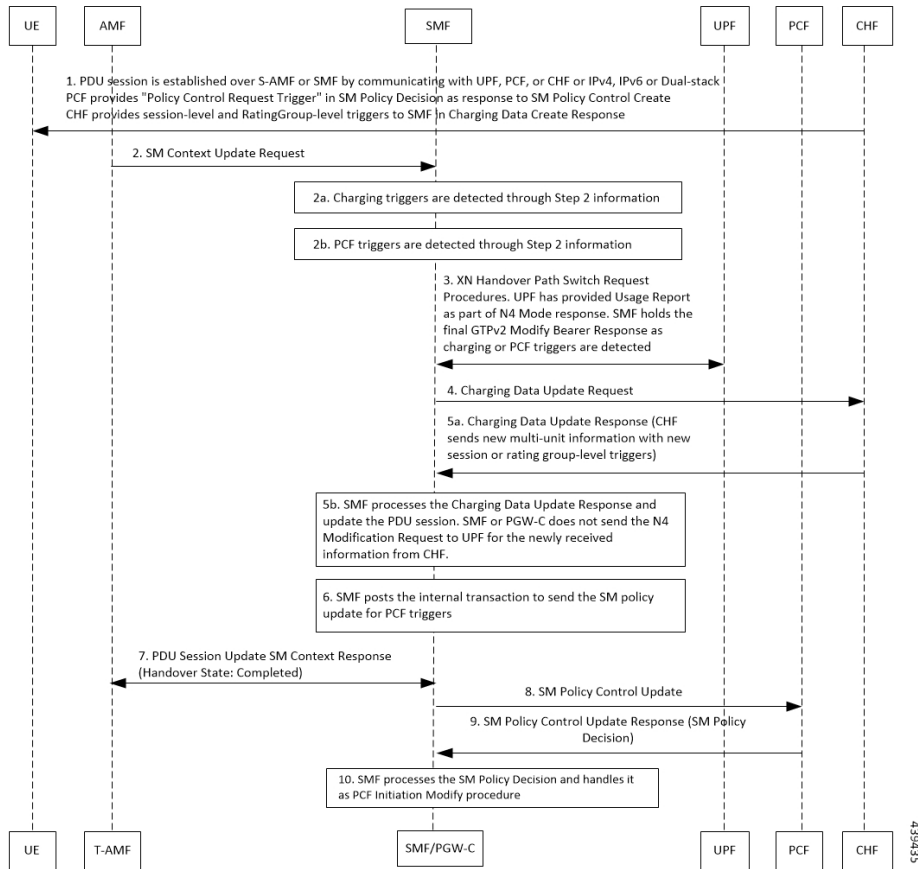*Figure 4: CHF and PCF Integration for Xn Handover Call Flow*



*Table 7: CHF and PCF Integration for Xn Handover Call Flow Description*

| Step | Description |
|---|---|
| 1 | The PDU session is established over MME, SGW, and SMF by communicating with UPF, PCF, or CHF for IPv4, IPv6, or dual-stack.<br><br>The PCF provides Policy Control Request trigger for SM policy decision as response to the request for creation of SM policy control.<br><br>The CHF provides session-level and rating-group-level triggers to SMF as the Charging Data Create Response. |
| 2 | The AMF sends SM Context Update Request to the SMF. The SM Context Update Request includes the information on UE location, UE time zone, and path switch request N2 message. |
| 2a | The SMF detects access-side changes that are received in the SM Context Update Request and the charging triggers with the information that is available in Step 2. |
| 2b | The SMF detects the PCF triggers with the information that is available in Step 2. |

| Step | Description |
|------|-------------|
| 3 | The Xn Handover Preparation procedure starts from SMF toward UPF and vice versa, as defined in 3GPP TS 23.502 section 4.9.1.2.<br><br>SMF sends the N4 Modification Request to UPF and updates the received DL tunnel information of T-gNB. After the tunnel information is updated, UPF provides the usage report as part of N4 modification response. The SMF holds the final SM Context Update Response when the SMF detects the CHF or PCF triggers. |
| 4 | The SMF sends the Charging Data Update Request to the CHF. This request includes the information on session-level triggers, multi-unit-Information (with rating-group-level triggers and usage report), customer identification, and PDU session charging information. |
| 5 | The CHF sends the Charging Data Update Response with optional multi-unit-information. The CHF also sends the new session or rating-group-level triggers to the SMF. |
| 5a | The SMF processes the Charging Data Update Response and updates the PDU session. The SMF does not send the N4 modification request to the UPF for the newly received information from the CHF. |
| 6 | The SMF posts the internal transaction to send the SM policy update information for PCF triggers. |
| 7 | The SMF sends the SM Context Update Response to the AMF. This response includes the path switch request acknowledgment N2 message. |
| 8 | The SMF sends the SM Policy Control Update information to the PCF. The SM Policy Control Update includes details, such as the user location information and UE time zone. |
| 9 | The PCF sends the SM Policy Control Update Response, which is the SM policy decision, to the SMF. |
| 10 | The SMF processes the SM policy decision that is received as response and handles the response as PCF Initiation Modify procedure, as defined in 3GPP TS 23.502, section 4.3.3.2. |

## CHF and PCF Integration for Service Request Procedures

This section describes the CHF and PCF integration for service request procedures.

SMF processes the received SM Context Update Request to update N3 tunnel path state from Idle to Active or Active to Idle. SMF performs the following steps:

1. When UE is in CM-Idle state at AMF, which is Active to Idle mode—Based on the configuration, SMF updates UPF for N3 tunnel state to drop or buffer by sending the N4 session mode request. Based on charging configuration, SMF receives a usage report. Based on the Charging Triggers that qualify during session creation, SMF sends the N40 Charging Update request.

2. When UE is in CM-Connected state at AMF, which implies SMF receives UE-requested Procedures to change the subscriber N3 Tunnel Path from Idle to Active State—SMF receives the updated user location and UE time zone in the SM Context Update Request. SMF sends the N4 Session Modification Request to UPF to update the DL tunnel details of gNB. Based on charging configuration, SMF receives a usage report. Based on the Charging Triggers that qualify during session creation, SMF sends the N40 Charging Update request.

3. When the N3 Tunnel is unavailable for the Network Service Request Triggers, which implies that UE is in CM-Idle state at AMF—SMF initiates the Network Service Request Procedures for AMF to initiate Paging toward the end user. Then, AMF begins the UE Service Request Procedures to configure the N3 Tunnel as specified in Step 2.

# Standards Compliance

The CHF and PCF integration for Intra-AMF and Inter-AMF N2-based handovers feature complies with the following standards:

- 3GPP TS 23.502 V15.2.0 (2018-09)